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*Published in:*  
Book of Abstracts. DTU's Sustain Conference 2015

*Publication date:*  
2015

*Document Version*  
Publisher's PDF, also known as Version of record

[Link back to DTU Orbit](#)

*Citation (APA):*  
Maresca, A., & Astrup, T. F. (2015). Utilization of biomass combustion ash for liming purposes on top of forest soils. In *Book of Abstracts. DTU's Sustain Conference 2015* [W-12] Technical University of Denmark.

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## Utilization of biomass combustion ash for liming purposes on top of forest soils

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The use of energy from wood combustion is becoming an increasingly popular source of renewable energy. Ashes are generated and although alternative uses – e.g. for liming and fertilizing purposes - have been proposed (e.g. Steenari et al., 1999), biomass ashes are commonly landfilled (Knapp & Insam, 2011). Benefits and risks owing to ash utilization have to be evaluated based on the ash chemical composition but also on the actual leaching release. Although several studies have focused on the ash composition and potential leaching release (e.g. Mellbo et al., 2008; Steenari et al., 1998; Zhan et al., 1996), the results are still fragmented.

In this study, two biomass combustion ash samples were investigated. The samples were characterized for their chemical composition, thus acid digested and analyzed by ICP-MS/OES. The long term leaching of the ash samples was investigated according to CEN/TS 14405:2004. Overall, higher contents of some plant nutrients – i.e. Ca, K, Mg, Mn and P - as well as of a few heavy metals - i.e. Cd and Ni - were found in the ash samples compared to Danish forest soil (Ingerslev et al., 2014). A long term leaching of alkaline compounds was found and although a decrease in the pH value – initial pH of 12.5 - was detected along the experiment, a pH value above 10.5 was registered at the L/S ratio 1000 l/kg. High releases of soluble compounds, such as K, Na and S were found, and drops of about two orders of magnitudes were shown by the L/S ratio 20 l/kg. The concentrations of P, Cd and Ni were always below detection limit: 15 µg/l, 0.20 µg/l and 0.52 µg/l respectively. Although similar patterns in the release of Cr were found by comparing the two ashes, the higher Cr releases were found for the fly ash sample.

The suitability of wood ash for liming purposes was confirmed. Although high contents of nutrients were found in our ash samples in comparison with the investigated Danish forest soil, their different solubility (e.g. K and P) limits the assessment of the actual fertilizing value of the ash. Considerable amounts of some soluble nutrients are likely to leach out after the first rain event, while others showed relatively small releases according to our results. Although generally low releases of heavy metals were found, their toxicity in relation to the actual soil organisms should be investigated to assess potential risks owing to ash utilization.

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